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In the last few years, investors have become increasingly interested in alternative assets. In general, these assets are not as easily accessible in the market as traditional assets (e.g., stocks, bonds, convertibles etc.) are and typically do not have as much liquidity. Several reasons have been cited for the interest of investors. First, alternative asset managers may market their funds as absolute return strategies which imply stable returns regardless of market conditions. Second, the correlations with traditional assets are assumed to be low, and, third, as already noted the funds involved cannot be easily accessed by traditional investors.

For several years, shipping has been among the sectors with the strongest growth in the global economy. It does not profit only from the solid growth of the world economy, but also from growth rates in world trade, which has clearly exceeded the growth rates in world production. For instance, according to the WTO, world merchandise trade has been growing by twice the annual growth rate of output since 2000. This, in turn, is a major driver of rising demand for transportation services, among which seaborne trade has increased significantly since 2000 (WTO [2007, p. 112]). The shipping industry is among the three most finance-intensive industries in the world. Just for financing new buildings, about $80 billion are needed annually (Goulielmos & Psifia [2006, p. 301]). Surprisingly, lately the shipping sector lately turned to the stock market to meet its equity financing needs. Since 2004, the number and volume of IPOs are much higher than before. Thus, market capitalization and number of listed maritime corporations have risen as well. According to Lloyd's shipping economist's statistics, the number of listed shipping corporations in 2006 amounted to 77 in Asia, 52 in Europe, and 37 in the U.S., respectively (Akca [2007, p. 185]; Rieck [2007]).

It goes without saying that investors are eager to invest in successful economic sectors such as the shipping sector. However, only due to the recently increased IPO activity have investors been able to easily access financial instruments that allow for participation in the maritime sector. Vendors of baskets of maritime stocks highlight their potential returns and their diversification benefits. This article focuses on the investment in shipping as an alternative asset class and investigates whether it actually disposes of the claimed properties.

After a short literature review and the formulation of the relevant hypotheses, the empirical analyses are conducted. We compare two portfolios: The base portfolio consists of bonds and stocks. The bond and stock performance are represented by the Lehman Bond Composite Global Index[1] and the MSCI World Index, respectively. The enhanced portfolio contains an investment in shipping as a third component. The MSCI World Marine Index represents the investment in shipping. It aggregates the performance of 10 major listed shipping stocks and has a relatively long data history. We apply three methods to investigate the diversification properties: correlation analysis, comparison of efficient portfolio frontiers, and a significance test of differences in Sharpe ratios.

LITERATURE REVIEW

There is a significant body of research available on the diversification potential of alternative assets such as hedge funds, private equity, and real estate. However, relatively little research has been done on investments in shipping. For hedge funds, most studies find that their inclusion in portfolios consisting only of bonds and stocks improves diversification, as defined by mean-variance portfolio performance (cf., e.g., Amin & Kat [2002; 2003]; French [2005]; Heidorn et al. [2007]). However, in addition, hedge funds might adversely affect higher moments of the distribution of portfolio returns, i.e., skewness and kurtosis (Amin & Kat [2002; 2003]). Moreover, Eling [2006] notes that hedge fund returns contain certain flaws, which might cause an overestimation of the diversification benefits of hedge funds in the literature.

For private equity, the majority of the studies find a diversification effect as well (see, for instance, Wahrenburg et al. [2003]; Emery [2003]; Milner & Vos [2003]; Schmidt [2006]), but there are some exceptions (cf., e.g., Zhu et al. [2004]; Ennis & Sebastian [2005]). A closer look reveals differences between the various kinds of private equity investments (see, for example, Emery [2003]; Milner & Vos [2003]). Additionally, as is the case with empirical analyses of other types of alternative asset classes, research in private equity investments suffers from a lack of adequate market data, which can result in overestimation of potential diversification properties (Emery [2003] tries to estimate the size of this effect). Christophers et al. [2006] analyze *listed* private equity investments, thus circumventing the above-mentioned data problem, and confirm the diversification benefit of private equity in a portfolio of stocks and bonds.

Real estate is the alternative asset class with the largest body of literature. In recent years, empirical studies have advanced in the sense that they do not only investigate whether real estate renders dominating efficient frontiers but also whether higher Sharpe ratios are possible. In addition, a procedure developed by Gibbons et al. [1989] to test whether an improvement of diversification is statistically significant has been applied. This procedure will be applied in this article as well and is explained below. Empirical studies show that diversification benefits are not (cf. Rubens et al. [1998]) or only in some situations statistically significant (cf. Hübner et al. [2004]). Moreover, many studies demonstrate that the diversification results depend on the particular proxy used to represent the investment in real estate; see, e.g., Maurer & Sebastian [1999]; Brounen & Eichholtz [2003]; Hoesli et al. [2003], Hübner et al. [2004], Morawski et al. [2008]. Usual proxies are indexes representing the prices for real estate, suffering from the lack of adequate price data mentioned above, real estate stocks, and, in the case of Germany, real estate mutual funds. According to the earlier literature reviews on investments in real estate by Khoo et al. [1993, pp. 109–113] and Maurer & Sebastian [1999, p. 182], empirical studies found similarities with regard to return characteristics between the general stock market and listed forms of real estate investment, e.g., REITs, but also noted remarkable differences between direct investments in real estate and listed forms of real estate investment. However, according to the more recent surveys of Morawski et al. [2008, pp. 105–107] and Hoesli & Camillo [2007, p. 60f.], the correlation between the general stock market and listed forms of real estate investment has declined in the last decade. Nevertheless it seem that returns on securitized real estate investments are more strongly influenced by stock returns rather than by the returns of direct real estate (Hoesli & Camillo [2007]). Thus, with respect to diversification qualities, it seems to matter whether the employed investment instrument is exchange traded or not.

Investments in shipping firms and their diversification potential in combination with other asset classes have not been researched in greater detail so far. A group of studies can be mentioned in this context analyzing the beta of shipping stocks with respect to the general stock market (Grammenos & Marcoulis [1996]; Kavussanos & Marcoulis [1997; 1998]; Kavussanos et al. [2003]; Gong et al. [2006]; Drobetz et al. [2008]). At the risk of some oversimplification, their findings can be summarized as follows: Explanatory power of the general stock market for shipping stocks returns is quite weak. Therefore, high volatility of shipping stocks—which we find in our empirical analysis—should not refrain investors from holding shipping stocks because a large part of their risk is unsystematic and can thus be diversified. The studies also find that systematic risk of shipping stocks does not differ much from the "average" listed corporation. Magirou et al. [1997] construct the hypothetical position of a ship owner which is characterized by the cash flows associated with a portfolio of different vessel types. Among other things, they find low or negative values for the covariance and the beta for different ship types against the Dow Jones Industrial Average Index. No significance tests had been done to verify the results. Nevertheless, this implies that, like real estate, the diversification properties of investments in shipping also depend on whether the investment is exchange-traded or not. A second strand of the literature on diversification issues of investments in shipping deals with the question whether an investment in a single vessel type is inferior to an investment in several kinds of vessel types; see Magirou et al. [1997]; Shen & Vogiatzis [2004]. However, this part of the literature is not relevant for our purposes.

HYPOTHESES

Initially, the boom in shipping in general might have induced people to invest their money in that sector, in speculation that extraordinary growth rates would translate into extraordinary appreciation of asset prices. Currently, prospective abnormal returns could have been the main driver, relegating only a secondary role to diversification considerations. We formulate our first hypothesis about shipping considerations:

> **Hypothesis 1**: Investments in shipping provide attractive risk-return combinations.

The main reason why asset managers' and investors' attention to new asset classes has been increasing in recent years is the potential diversification benefit derived from these assets. If their correlation to traditional assets such as stocks and bonds were sufficiently low, more efficient risk-return combinations could be achieved by investments in these new asset classes. Hence, our second and main hypothesis is formulated as follows:

> **Hypothesis 2**: Adding a shipping component to traditional stock and bond portfolios enables investors to achieve more efficient risk-return combinations.

DATABASE AND DESCRIPTIVE STATISTICS

In order to assess whether investments in shipping as a *new* asset class might enhance the diversification potential of a traditional stock and bond portfolio, it is necessary to define the *traditional* asset classes already available to investors. In our investment universe, investors may invest in a well-diversified stock portfolio and in a well-diversified bond portfolio. The stock portfolio is represented by the MSCI World Index. The index is designed to measure global developed market equity performance. The Lehman Bond Composite Global Index serves the same task for bonds. It is evenly made up of the Lehman U.S. Government Bond Index, the Lehman Investment Grade Corporate Bond Index, the Lehman Mortgage Backed Bond Index, and the Lehman Majors EX-U.S. Government Bond Index. Data are from the website of MSCI Barra (www.mscibarra.com, visited at 28.4.2008) and Datastream, respectively.

We employ the ClarkSea Index to reflect economic activity in the shipping sector. The index is not a stock index, but aggregates the earnings for all main commercial vessel types, i.e., oil tankers, dry bulk carriers, gas carriers, and containerships, weighted by the number of vessels in each fleet sector. The unit of the index is US$ per day. The index has the advantage that it is calculated weekly and that it is based on actual rates; for further details, cf. Clarkson Research Studies [2005]. Thus, the data biases caused by the infrequent availability of transaction prices which plague studies of many other unlisted assets do not arise. Analysis of the ClarkSea Index will provide preliminary evidence as to the properties of investments in shipping in general. However, it has to be mentioned that the ClarkSea Index only represents the earnings' side, but ignores the cost side, e.g., operating costs, completely. It also does not consider the development of the ships' market value and their financing structure. In contrast to that, stock prices could be regarded as "net measures," aggregating all these factors. Data is retrieved from Clarkson's Shipping Intelligence Network (www.clarksons.net/markets, visited at April 28, 2008).

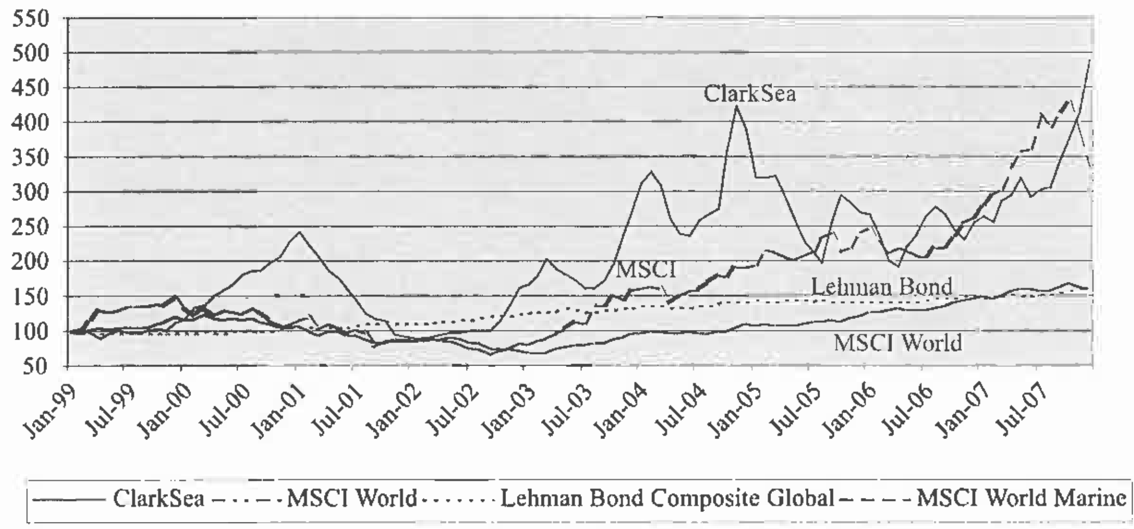
We then turn to the MSCI World Marine Index. The index aggregates the performance of 10 major listed shipping stocks and thus represents a diversified and liquid investment instrument investors can apply to take a long or short position in shipping sector exposure. The main advantage of this index for our purposes is its comparatively long history, enabling us to cover a sample period of nine years. However, the MSCI World Marine Index has its drawbacks as well. Particularly, the number of 10 constituents is rather small. Moreover, as the weighting scheme depends on market capitalization, the weight of the largest two constituents amounts to about 50%. As a consequence, the diversification properties of the MSCI World Marine Index must be considered only as moderate. We will come back to this issue in the robustness checks section. Index data are retrieved from Datastream.

All indexes enter the analysis as performance indexes and on a U.S.$ basis. We analyze discrete monthly returns since they are more robust when used for calculations in a portfolio context than continuous returns (Poddig et al. [2000, pp. 151–152]). The MSCI World Marine Index is the newest of our four indexes and was established in the late nineties. Still, the time span from January 1999 to December 2007, our sample period, includes a bear market and a bull market period at the stock market.

Despite standardization of all time series to 100, the bear and bull periods in the general stock market are hard to detect in Exhibit 1 because development of the two shipping indexes covers a much wider range. The ClarkSea Index displays the largest amplitude. The connection between the ClarkSea Index and the MSCI World Marine Index seems to vary over time. They appear to track each other quite well from mid 2005 on, but then deviate towards the end of the sample period. As mentioned above, stock prices could be considered as "net measures", aggregating earnings, costs, asset values, financing structures, etc. in the shipping sector whereas the ClarkSea Index only reflects the earnings' side. This could explain diverging patterns in the time series of MSCI World Marine Index and ClarkSea Index. Moreover, being traded on an exchange and thus being part of the international financial community might be an additional and independent factor affecting the prices of shipping stocks, but not the ClarkSea Index.[2]

Both Jarque-Bera and Kolmogorov-Smirnov tests reveal that for all four return time series the null hypothesis of normal distribution cannot be rejected (Exhibit 2). Usually, stocks are expected to offer a higher mean return, but with higher risk. This pattern can be found as well, but the performance advantage of the MSCI World over the Bond index is small only compared to its risk disadvantage. Economic activity in the shipping sector, as evidenced by the ClarkSea Index, has generated on average rather strong earnings, but has been highly volatile as well. The MSCI World Marine Index seems to be a cushioned reflection of the ClarkSea Index. The results for both shipping measures support hypothesis 1 that the shipping sector provides attractive risk-return combinations.

EXHIBIT 1
Indexes from January 1999 to December 2007



Note: All indexes standardized to 100 in January 1999.

EXHIBIT 2
Descriptive Return Statistics

	Index			
Statistic	MSCI World Index	Lehman Bond Composite Global Index	ClarkSea Index	MSCI World Marine Index
N	108	108	108	108
Mean	0.54%	0.45%	1.85%	1.31%
Median	0.94%	0.48%	1.78%	1.59%
Minimum	−10.98%	−2.71%	−17.68%	−20.01%
Maximum	8.93%	3.01%	29.90%	21.93%
Stand. Dev.	3.86%	1.15%	9.53%	6.95%
Skewness	−0.4406	−0.1807	0.3949	−0.1617
Kurtosis	0.2182	−0.0917	−0.0737	0.5364
Kolmogorov-Smirnov				
Test statistic	0.7865	0.5017	0.5931	0.6489
p-value	0.5663	0.9629	0.8732	0.7938
Jarque-Bera				
Test statistic	3.5027	0.6630	2.7995	1.3969
p-value	0.1735	0.7178	0.2467	0.4973

Note: Discrete monthly returns from January 1999 to December 2007.

EXHIBIT 3
Pearson Correlation of Monthly Returns

	Correlation Coefficients			
Index	MSCI World	Lehman Bond	ClarkSea	MSCI W Marine
MSCI World Index	1.00	−0.08	0.07	0.56***
Lehman Bond Composite Global Index		1.00	0.11	0.18*
ClarkSea Index			1.00	0.01
MSCI World Marine Index				1.00

*Note: Discrete monthly returns from January 1999 to December 2007. ***/**/* denotes correlation coefficients with a p-value better than 0.01/0.05/0.10 (two-sided).*

Stocks and bonds are generally almost uncorrelated with the correlation coefficient not being significantly different from zero. A similar result is found for activity in the shipping sector in general, which is reflected in the ClarkSea Index. Its correlation coefficient with both MSCI World Index and Lehman Bond Composite Global Index does not differ significantly from zero (Exhibit 3). This is the first tentative evidence that investments in shipping, in accordance with hypothesis 2, offer diversification benefits. However, the most interesting results of the correlation analysis are the coefficients of the MSCI World Marine Index, particularly if contrasted with the coefficients of the ClarkSea Index. In marked contrast to the ClarkSea Index, the MSCI World Marine Index is quite strongly correlated with the general stock market and with the bond market as well. As the MSCI World Index consists of more than 1,500 components, its close correlation with the MSCI World Marine Index (10 components) cannot be explained simply by the technical aspect that the latter is part of the former. Surprisingly, ClarkSea Index and MSCI World Marine Index are almost uncorrelated with each other over the complete sample period. However, according to Exhibit 1, their relationship appears to vary over time and there seems to be time periods of quite close correlation. Consequently, at this stage of our analysis, this finding casts some doubts on the diversification benefits of investments in shipping *stocks* derived above from the results for the ClarkSea Index.

EFFICIENT FRONTIER ANALYSIS

Method

In this section, we construct and compare efficient frontiers by combining several of the aforementioned indexes. The base case is an investor who is able to invest in well diversified stock and bond portfolios and will choose a portfolio composition based on efficient frontier analysis of this investment universe. In a second step, we treat the ClarkSea Index as an additional, hypothetical, investment opportunity and analyze whether its addition improves the efficient frontier. If it actually does, this would support the idea that investments in shipping might yield diversification benefits. To test this idea more rigorously, we investigate in a third and final step the effects of the MSCI World Marine Index on the efficient frontier. This index represents an instrument which enables actual and low transaction cost investments in shipping.

At the center of the analysis in this section is the efficient frontier. According to portfolio theory, a portfolio is efficient if no other portfolio with the same expected return has a lower volatility or if no other portfolio with the same level of volatility yields a higher expected return, respectively. We use realized returns in order to estimate return moments.

The efficient frontier for a given investment opportunity set, excluding short sales, is identified in the following manner: The risk-return profile of the maximum return portfolio is computed. This portfolio only contains the maximum return asset and is the rightmost point of the efficient frontier. The leftmost point is the minimum variance portfolio. Its composition is calculated with Equation (1). After its risk-return profile has been determined, 18 equidistant target returns between the maximum return portfolio and the minimum variance portfolio are computed. After that, Equations (1) to (4) are utilized to calculate the risk-return combinations of the 18 prescribed target returns.

$$\sigma_P^2 = \sum_{i=1}^{N}\sum_{j=1}^{N} w_i w_j \sigma_{ij} \quad \text{(Minimizing portfolio risk)} \quad (1)$$

$$\sum_{i=1}^{N} w_i \mu_i = r_P^* \quad \text{(Given expected return)} \quad (2)$$

$$\sum_{i=1}^{N} w_i = 1 \quad \text{(Budget restriction)} \quad (3)$$

$$w_i \geq 0 \quad \text{(No short selling)} \quad (4)$$

with

σ_P^2 Variance of portfolio P
w_i Share of investment i in portfolio P
σ_{ij} Covariance between investment i and j
μ_i Mean return of investment i
r_P^* Given return of portfolio P
N Number of assets

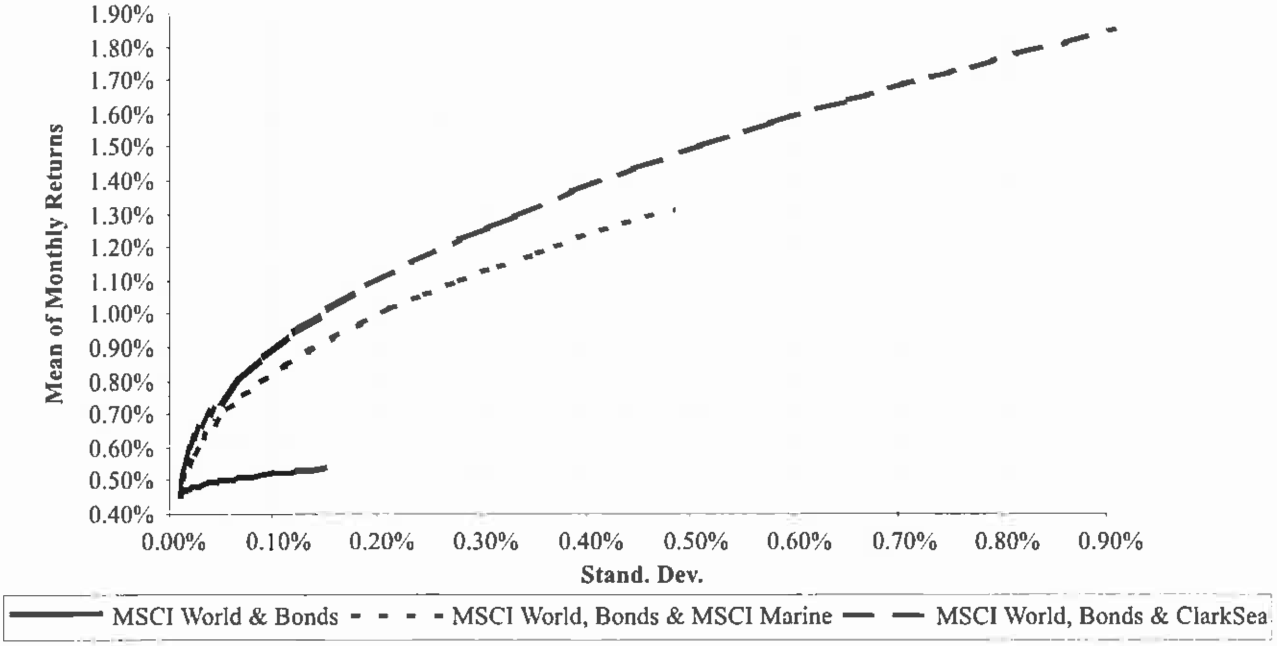
Results

We look at three efficient frontiers: Our base case is made up of portfolios consisting of standard stocks and bonds. Furthermore, we investigate two three-component portfolios, in each of which one of our two proxies for investments in shipping, the ClarkSea Index and the MSCI World Marine Index, is added to the base-case portfolio to evaluate the potential diversification properties of investments in shipping. The results are presented in Exhibit 4.

Due to the developments in the global stock and bond markets from 1999 to 2007, the efficient frontier of portfolios consisting of the MSCI World Index and the Lehman Bond Composite Global Index is rather short. The efficient frontiers of both three-component portfolios always dominate the efficient frontiers of the base-case portfolios. As to the relationship between both types of shipping components, base-case portfolios supplemented with the ClarkSea Index dominate over those portfolios in which the MSCI World Marine Index represents the shipping component. However, the distance between these two efficient frontiers is much

Exhibit 4

Efficient Frontier Analysis



Notes: Discrete monthly returns from January 1999 to December 2007. MSCI World: MSCI World Index; Bonds: Lehman Bond Composite Global Index; MSCI Marine: MSCI World Marine Index; ClarkSea: ClarkSea Index.

smaller than their distance to the efficient frontier of the base-case portfolio.

Discussion

With regards to hypothesis 2, the evidence in this section is unambiguous and does not need much discussion: In our sample period, participation in shipping would have yielded diversification gains even to those investors who already held a globally diversified portfolio in developed market stocks and bonds. In view of the correlation analysis conducted in Exhibit 3, the ranking of the three portfolios in terms of diversification properties comes as no surprise: The three-component portfolio with the ClarkSea Index is in the lead, the base-case portfolio is situated at the bottom of the figure, and the three-component portfolio with the MSCI World Marine Index can be found between the two. What is surprising, however, is the distance between the efficient frontiers: Recalling the significantly positive correlation coefficients between the MSCI World Marine Index on the one hand and the MSCI World Index and the Lehman Bond Composite Global Index, respectively, on the other, we would have expected the efficient frontier of portfolios including the MSCI World Marine Index to be more distant from that of portfolios including the ClarkSea Index and closer to that of the base-case portfolio.

SIGNIFICANCE TEST OF THE DIVERSIFICATION PROPERTIES

Method

In the recent literature on the diversification properties of real estate, a procedure has emerged that allows the application of a significance test developed by Gibbons et al. [1989] to analyze whether the addition of a further component to a portfolio enhances diversification; cf., e.g., Rubens et al. [1998], Cheng & Liang [2000], and Hübner et al. [2004] for applications of this procedure. It benefits from the fact that the Sharpe ratio (Sharpe [1966]) measures the return *and* the risk characteristic of an asset or a portfolio in a single number. It relates the excess return of an investment position to its risk. For realized returns, the Sharpe ratio of a portfolio P can be written as:

$$S_P = \frac{\mu_P - r_f}{\sigma_P} \tag{5}$$

with

S_P Sharpe ratio of portfolio P
μ_P Mean return of portfolio P
σ_P Standard deviation of portfolio P
r_f Risk free rate of return

We approximate the risk free rate of return with the 6-month US$ LIBOR (data from Datastream). The approach based on Gibbons et al. [1989] allows one to test the hypothesis that the Sharpe ratios of two portfolios differ significantly.[3] For instance, suppose there is a base portfolio B composed of standard assets and an enhanced portfolio E, which additionally contains alternative asset classes. The following null hypothesis is testable: The Sharpe ratio of portfolio B (S_B) does not differ significantly from the Sharpe ratio of portfolio E (S_E). Gibbons et al. [1989] develop the following test statistic for this hypothesis:

$$W = \left[\frac{\sqrt{1+S_E^2}}{\sqrt{1+S_B^2}}\right] - 1 \tag{6}$$

with

S_B Sharpe ratio of the base portfolio
S_E Sharpe ratio of the enhanced portfolio

Measuring a value of W that differs significantly from zero would mean that one of the portfolios under investigation outperforms the other portfolio with respect to its mean-variance properties in a statistically significant manner. The Wishart distributed test statistic W can be transformed into an F-distributed test statistic:

$$\frac{T(T-N-1)}{N(T-2)} W \sim F_{N,(T-N-1)} \tag{7}$$

with

T Number of observations
N Number of assets

The transformation only applies to non-negative values of W. To test whether the enhanced portfolio produces a statistically significant better Sharpe ratio, (6) is straightforward as long as $S_E > S_B \geq 0$ holds. Otherwise the equation has to be modified accordingly. The power of the test statistic depends on the relation between T and N; Gibbons et al. [1989, p. 1136] mention a threshold of $T/N \geq 3$, which is straightforward for our data set.

Next, the composition of the base portfolio and of the enhanced portfolio has to be discussed. Two aspects have to be considered: Which components should be part of the portfolios, and which rules should govern the weights of its components? As to the first question, it suffices to consider a base portfolio consisting of the MSCI World Index and the Lehman Bond Composite Global Index with an enhanced three-component portfolio, which additionally contains a shipping component.

Concerning the second aspect, several variants can be found in the literature: A rule-of-thumb-based base portfolio, which is not necessarily efficient, is compared with an enhanced portfolio of the same type; a part of the analysis in Hübner et al. [2004] follows this approach. Alternatively, rule-based efficient portfolios are being analyzed, with the minimum-variance portfolio, the maximum-Sharpe-ratio portfolio, and the maximum-return portfolio being the most popular ones. Thus, three more methods become available: rule-of-thumb-based base portfolios versus rule-based efficient enhanced portfolios (e.g., Rubens et al. [1998]; Cheng & Liang [2000]) and vice versa, and rule-based efficient base portfolios versus rule-based efficient enhanced portfolios (e.g., Hübner et al. [2004]).

In our analysis, the base portfolio is assembled according to three different rules of thumb, giving weights of 75%/25%, 50%/50% and 25%/75% to the MSCI World Index and the Lehman Bond Composite Global Index, respectively. We think that these portfolio structures adequately represent the portfolios of real-world investors with different degrees of risk aversion. Moreover, the question of portfolio efficiency is not that important in the case of two-component portfolios.

The real-world investor also guided our considerations concerning the enhanced portfolio: Realistically, participation in stocks of a single economic sector cannot be more than a supplement of a rather limited size to a widely diversified portfolio consisting of the MSCI World Index and the Lehman Bond Composite Global Index, whatever any efficiency-based rules might prescribe. For instance, if the portfolio composition rule suggested a 60% stake in the MSCI World Marine Index, a 40% stake in the Lehman Bond Composite Global Index, and a 0% stake in the MSCI World Index to achieve a prescribed portfolio return on the efficient frontier, this portfolio composition would not be a realistic recommendation. Hence, we limit the portfolio weight of the MSCI World Marine Index to 20%. We increase the weight of the MSCI World Marine Index in steps of five percentage points to 20%, simultaneously reducing the share of the MSCI World Index accordingly. Thus, the relative proportion between stock and bond investment remains unchanged.[4]

Results

The results from the significance test of the diversification properties of the MSCI World Marine Index are displayed in Exhibit 5.

Panel A displays the return, standard deviation, and Sharpe ratio of the base portfolio consisting of a 25% stake in the MSCI World Index and a 75% stake in the Lehman Bond Composite Global Index. The following rows show the changing effects on these measures by replacing the MSCI World Index by the MSCI World Marine Index in steps of five percentage points. Further, on the right-hand side of these rows, *F*-statistics and p-values allow one to evaluate whether the enhanced portfolio produces a statistically significant diversification advantage compared to the base portfolio. The numbers unambiguously reveal that support for this conjecture is far from being significant.

Panel B is arranged identically for the base portfolio consisting evenly of the MSCI World Index and the Lehman Bond Composite Global Index. The basic results are also identical. The same is true for the third base portfolio, which contains a 75% stake in the MSCI World Index and a 25% stake in the Lehman Bond Composite Global Index. For the sake of brevity, these results are untabulated.

Discussion

The supportive evidence in the previous section for hypothesis 2 is confirmed by the Sharpe ratios in Exhibit 5. Both panels demonstrate that supplementing a conventional portfolio with an investment in shipping stocks leads to higher Sharpe ratios, i.e., more advantageous risk-return combinations. The increase in Sharpe ratios of four and six basis points, respectively, can be described as being *economically* significant, i.e., diversification benefits are substantial. However, the significance test clearly shows that the diversification benefits are not *statistically* significant. This finding—evidence of a substantial diversification benefit which is not statistically significant—is consistent with the results found by Rubens et al. [1998] and Hübner et al. [2004] in a similar setting for real estate investments.

In untabulated results, we replicate this analysis with the ClarkSea Index instead of the MSCI World Marine Index as proxy for the shipping sector investment. The analysis yields similar results. In view of the previous findings, it is not surprising that diversification benefits for the ClarkSea Index are greater than for the corresponding portfolio with the MSCI World Marine Index. They amount to increases in the Sharpe ratios of 7 and 10 basis points, respectively, instead of 4 and 6 basis points, respectively. But nevertheless, these results are far from being statistically significant as well. The best p-value amounts to 0.46, which compares with 0.72, which is the best p-value for a portfolio with the MSCI World Marine Index representing shipping.[5]

The discrepancy between economical and statistical significance is remarkable. For the investor, the conclusion might be to not put too much emphasis on statistical significance. The diversification benefits of investments in shipping stocks are certainly substantial to warrant consideration in a portfolio.

ROBUSTNESS CHECKS

Proxy for Investment in Bonds

We conduct a series of robustness checks. Among other things, we replace our proxy for the investment in bonds, the Lehman Bond Composite Global Index, by the JP Morgan Government Bond Index, which aggregates government bonds from developed countries. It is thus somewhat less diversified than the Lehman

EXHIBIT 5

Significance Test of the Diversification Properties of the MSCI World Marine Index for the Full Sample Period

Panel A: Diversification Effects of Adding the MSCI World Marine Index to a Base Portfolio with the Lehman Bond Composite Global Index (75%) and the MSCI World Index (25%)

Components	Weights	Return	Stand. Dev.	Sharpe Ratio	F-Statistic	p-Value of F
Lehman Bond	75.00%					
MSCI World	25.00%	0.47%	1.24%	0.12		
MSCI Marine	0.00%					
Lehman Bond	75.00%					
MSCI World	20.00%	0.51%	1.33%	0.14	0.19	0.90
MSCI Marine	5.00%					
Lehman Bond	75.00%					
MSCI World	15.00%	0.55%	1.46%	0.15	0.33	0.80
MSCI Marine	10.00%					
Lehman Bond	75.00%					
MSCI World	10.00%	0.59%	1.64%	0.16	0.41	0.75
MSCI Marine	15.00%					
Lehman Bond	75.00%					
MSCI World	5.00%	0.63%	1.85%	0.16	0.44	0.72
MSCI Marine	20.00%					

Panel B: Diversification Effects of Adding the MSCI World Marine Index to a Base Portfolio with the Lehman Bond Composite Global Index (50%) and the MSCI World Index (50%)

Components	Weights	Return	Stand. Dev.	Sharpe Ratio	F-Statistic	p-Value of F
Lehman Bond	50.00%					
MSCI World	50.00%	0.49%	1.97%	0.08		
MSCI Marine	0.00%					
Lehman Bond	50.00%					
MSCI World	45.00%	0.53%	2.01%	0.10	0.11	0.95
MSCI Marine	5.00%					
Lehman Bond	50.00%					
MSCI World	40.00%	0.57%	2.10%	0.12	0.23	0.88
MSCI Marine	10.00%					
Lehman Bond	50.00%					
MSCI World	35.00%	0.61%	2.21%	0.13	0.32	0.81
MSCI Marine	15.00%					
Lehman Bond	50.00%					
MSCI World	30.00%	0.65%	2.36%	0.14	0.40	0.75
MSCI Marine	20.00%					

*Note: The analysis uses discrete monthly returns from January 1999 to December 2007. The Sharpe ratio is defined as $S_p = \frac{\mu_p - r_f}{\sigma_p}$ with S_p: Sharpe ratio of portfolio P, μ_p: mean return of portfolio P, σ_p: standard deviation of portfolio P, r_f: risk free rate of return. Here, the 6-months U.S.$ LIBOR is used to approximate the risk free rate of return. The F-value is obtained from the following transformation: $\frac{T(T-N-1)}{N(T-2)} W \sim F_{N(T-N-1)}$ with T: number of observations (108), N: number of assets (3). W is defined as $W = \left[\frac{\sqrt{1+S_E^2}}{\sqrt{1+S_B^2}}\right] - 1$ with S_B: Sharpe ratio of base portfolio B (MSCI World Index and Lehman Bond Composite Global Index), S_E: Sharpe ratio of enhanced portfolio E (base portfolio supplemented with the MSCI World Marine Index). The p-value refers to the null hypothesis: The Sharpe ratio of the enhanced portfolio is significantly better than the Sharpe ratio of the base portfolio. ***/**/* denotes a F-statistic with a p-value better than 0.01/0.05/0.10.*

Index, which also contains bonds that are not issued by governments. Data are from Datastream. Replicating the analysis above with the JP Morgan Government Bond Index does not yield substantially different results.

Proxy for Investment in Shipping Stocks

So far, we have utilized the MSCI World Marine Index as proxy for investments in shipping stocks. This index has the advantage that historical data is available for a span of time that allows a fairly robust analysis. However, as it only consists of 10 stocks, one might doubt whether it is an adequate proxy for a *diversified* investment in shipping stocks, in light of the fact that the two largest constituents have an aggregated weight of 50% (as of May 2007). For this reason, we assembled a research index ourselves. It is based on the stocks of container, tanker, and bulker companies that make up the following indexes and stock lists, respectively: Clarkson Liner Share Price Index and Clarkson Tanker Share Price Index (www.clarksons.com, visited at 28.4.2008); dry bulk stocks listed in Dry Bulk Insight, a monthly report published by Drewry Publications (www.drewry.co.uk, visited on April 28, 2008). Additionally, the shipping news service Trade Winds was considered (www.tradewinds.no, visited at 28.4.2008). We select a group of 41 stocks for which return data were available for the full sample period from January 1999 to December 2007 and calculate an equally-weighted index.

EXHIBIT 6
Descriptive Statistics of the Research Index

Panel A: Descriptive Return Statistics

	Index				
Statistic	**MSCI World Index**	**Lehman Bond Composite Global Index**	**ClarkSea Index**	**MSCI World Marine Index**	**Research Index**
N	108	108	108	108	108
Mean	0.54%	0.45%	1.85%	1.31%	3.11%
Median	0.94%	0.48%	1.78%	1.59%	3.16%
Minimum	−10.98%	−2.71%	−17.68%	−20.01%	−13.92%
Maximum	8.93%	3.01%	29.90%	21.93%	17.69%
Stand. Dev.	3.86%	1.15%	9.53%	6.95%	6.37%
Skewness	−0.4406	−0.1807	0.3949	−0.1617	0.0274
Kurtosis	0.2182	−0.0917	−0.0737	0.5364	0.2479
Kolmogorov-Smirnov					
Test statistic	0.7865	0.5017	0.5931	0.6489	0.5285
p-value	0.5663	0.9629	0.8732	0.7938	0.9427
Jarque-Bera					
Test statistic	3.5027	0.6630	2.7995	1.3969	0.1615
p-value	0.1735	0.7178	0.2467	0.4973	0.9224

Panel B: Pearson Correlation of Monthly Returns

	Correlation Coefficients				
Index	**MSCI World**	**Lehman Bond**	**ClarkSea**	**MSCI W Marine**	**Research Index**
MSCI World Index	1.00	−0.08	0.07	0.56***	0.59***
Lehman Bond Composite Global Index		1.00	0.11	0.18**	0.12
ClarkSea Index			1.00	0.01	0.15
MSCI World Marine Index				1.00	0.73***
Research Index					1.00

Note: The Research Index assembles 41 equally weighted stocks of container, tanker, and bulker companies. See also the notes to Exhibit 2 and Exhibit 3.

EXHIBIT 7

Significance Test of the Diversification Properties of the Research Index from January 1999 to December 2007

Panel A: Diversification Effects of Adding the Research Index to a Base Portfolio with the Lehman Bond Composite Global Index (75%) and the MSCI World Index (25%)

Components	Weights	Return	Stand. Dev.	Sharpe Ratio	F-Statistic	p-Value of F
Lehman Bond MSCI World Research Index	75.00% 25.00% 0.00%	0.47%	1.24%	0.12		
Lehman Bond MSCI World Research Index	75.00% 20.00% 5.00%	0.60%	1.30%	0.21	1.08	0.36
Lehman Bond MSCI World Research Index	75.00% 15.00% 10.00%	0.73%	1.40%	0.29	2.40	0.07*
Lehman Bond MSCI World Research Index	75.00% 10.00% 15.00%	0.86%	1.54%	0.34	3.67	0.01**
Lehman Bond MSCI World Research Index	75.00% 5.00% 20.00%	0.99%	1.71%	0.39	4.73	0.00***

Panel B: Diversification Effects of Adding the Research Index to a Base Portfolio with the Lehman Bond Composite Global Index (50%) and the MSCI World Index (50%)

Components	Weights	Return	Stand. Dev.	Sharpe Ratio	F-Statistic	p-Value of F
Lehman Bond MSCI World Research Index	50.00% 50.00% 0.00%	0.49%	1.97%	0.08		
Lehman Bond MSCI World Research Index	50.00% 45.00% 5.00%	0.62%	1.99%	0.15	0.52	0.67
Lehman Bond MSCI World Research Index	50.00% 40.00% 10.00%	0.75%	2.05%	0.21	1.25	0.30
Lehman Bond MSCI World Research Index	50.00% 35.00% 15.00%	0.88%	2.14%	0.26	2.09	0.11
Lehman Bond MSCI World Research Index	50.00% 30.00% 20.00%	1.01%	2.26%	0.30	2.96	0.04**

Note: The Research Index assembles 41 equally weighted stocks of container, tanker, and bulker companies. See also the notes to Exhibit 5.

Thus, the Research Index is more diversified than the MSCI World Marine Index for two reasons: The number of constituents is much larger and the weighting scheme reduces the importance of large corporations. Stock prices, on a US$ basis and adjusted for capital actions and dividends, are from Datastream.

Descriptive statistics (Exhibit 6) reveal that the MSCI World Marine Index does not fully capture the dynamics of shipping stocks in recent years. Average monthly returns of the Research Index clearly outperform the MSCI World Marine Index (3.11% vs. 1.31%) whereas the standard deviation of both time series is quite similar. Turning to correlation analysis, we find a close correlation between Research Index and MSCI World Marine Index and a similar correlation of the two with the MSCI World Index. However, there are differences between the two indices as well: The Research Index is more closely, though still insignificantly, associated with the ClarkSea Index and less closely related with Lehman Bond Index than the MSCI World Marine Index.

We reproduce the significance analysis for the Research Index instead of the MSCI World Marine Index. The results are quite interesting (Exhibit 7):

The increase in the Sharpe ratios is much greater than those calculated for the MSCI World Marine Index. They amount to 27 and 22 basis points, respectively, compared to four and six, respectively, in Exhibit 5. As a consequence, the p-values are much better as well. For the first time, significance levels below 10% can be reported. Comparing the results for the Research Index with the MSCI World Marine Index, the conclusion is clear without ambiguity: The increases in the Sharpe ratios and the strong p-values for the Research Index should be attributed mainly to the index composition. The strong p-values are even more impressive if one takes into account that this kind of significance test requires comparatively substantial differences in the Sharpe ratios to imply statistical significance. It seems that it is worth the effort to assemble a portfolio of shipping stocks from more than ten different issuing corporations and to avoid attributing dominant weights

EXHIBIT 8

Pearson Correlation of Monthly Returns during the Bear Market Period from March 2000 to March 2003

	Correlation Coefficients			
Index	**MSCI World**	**Lehman Bond**	**MSCI W Marine**	**Research Index**
MSCI World Index	1.00	−0.19	0.56***	0.68***
Lehman Bond Composite Global Index		1.00	0.25	0.04
MSCI World Marine Index			1.00	0.73***
Research Index				1.00

Note: See notes to Exhibit 3.

EXHIBIT 9

Pearson Correlation of Monthly Returns during the Bull Market Period from April 2003 to October 2007

	Correlation Coefficients			
Index	**MSCI World**	**Lehman Bond**	**MSCI W Marine**	**Research Index**
MSCI World Index	1.00	0.13	0.48***	0.61***
Lehman Bond Composite Global Index		1.00	0.27**	0.34**
MSCI World Marine Index			1.00	0.77***
Research Index				1.00

Note: See notes to Exhibit 3.

Exhibit 10

Significance Test of the Diversification Properties of Investments in Shipping Stocks during the Bear Market Period from March 2000 to March 2003

Panel A: Diversification Effects of Adding the MSCI World Marine Index to a Base Portfolio with the Lehman Bond Composite Global Index (75%) and the MSCI World Index (25%)

Components	Weights	Return	Stand. Dev.	Sharpe Ratio	F-Statistic	p-Value of F
Lehman Bond	75.00%					
MSCI World	25.00%	0.23%	1.34%	−0.07		
MSCI Marine	0.00%					
Lehman Bond	75.00%					
MSCI World	20.00%	0.27%	1.41%	−0.04	0.04	0.99
MSCI Marine	5.00%					
Lehman Bond	75.00%					
MSCI World	15.00%	0.30%	1.52%	−0.01	0.05	0.98
MSCI Marine	10.00%					
Lehman Bond	75.00%					
MSCI World	10.00%	0.34%	1.68%	0.01	0.05	0.98
MSCI Marine	15.00%					
Lehman Bond	75.00%					
MSCI World	5.00%	0.37%	1.87%	0.03	0.04	0.99
MSCI Marine	20.00%					

Panel B: Diversification Effects of Adding the Research Index to a Base Portfolio with the Lehman Bond Composite Global Index (75%) and the MSCI World Index (25%)

Components	Weights	Return	Stand. Dev.	Sharpe Ratio	F-Statistic	p-Value of F
Lehman Bond	75.00%					
MSCI World	25.00%	0.23%	1.34%	−0.07		
Research Index	0.00%					
Lehman Bond	75.00%					
MSCI World	20.00%	0.36%	1.35%	0.03	0.04	0.99
Research Index	5.00%					
Lehman Bond	75.00%					
MSCI World	15.00%	0.50%	1.40%	0.13	0.14	0.93
Research Index	10.00%					
Lehman Bond	75.00%					
MSCI World	10.00%	0.63%	1.47%	0.21	0.48	0.70
Research Index	15.00%					
Lehman Bond	75.00%					
MSCI World	5.00%	0.77%	1.57%	0.29	0.90	0.45
Research Index	20.00%					

to the largest constituents. The result underlines the findings from the main section that investments in shipping stocks promise to offer substantial diversification benefits and gives some guidance as to the construction of the shipping position.

Sample Period

Furthermore, we check whether our results are sensitive with respect to the sample period. Kavussanos & Marcoulis [1997] analyze for a sample of 28 listed U.S.

Exhibit 10 (*Continued*)

Panel C: Diversification Effects of Adding the MSCI World Marine Index to a Base Portfolio with the Lehman Bond Composite Global Index (50%) and the MSCI World Index (50%)

Components	Weights	Return	Stand. Dev.	Sharpe Ratio	F-Statistic	p-Value of F
Lehman Bond	50.00%					
MSCI World	50.00%	–0.28%	2.35%	–0.26		
MSCI Marine	0.00%					
Lehman Bond	50.00%					
MSCI World	45.00%	–0.25%	2.35%	–0.24	0.08	0.97
MSCI Marine	5.00%					
Lehman Bond	50.00%					
MSCI World	40.00%	–0.21%	2.38%	–0.22	0.18	0.91
MSCI Marine	10.00%					
Lehman Bond	50.00%					
MSCI World	35.00%	–0.18%	2.45%	–0.20	0.28	0.84
MSCI Marine	15.00%					
Lehman Bond	50.00%					
MSCI World	30.00%	–0.14%	2.54%	–0.18	0.37	0.77
MSCI Marine	20.00%					

Panel D: Diversification Effects of Adding the Research Index to a Base Portfolio with the Lehman Bond Composite Global Index (50%) and the MSCI World Index (50%)

Components	Weights	Return	Stand. Dev.	Sharpe Ratio	F-Statistic	p-Value of F
Lehman Bond	50.00%					
MSCI World	50.00%	–0.28%	2.35%	–0.26		
Research Index	0.00%					
Lehman Bond	50.00%					
MSCI World	45.00%	–0.15%	2.33%	–0.20	0.08	0.97
Research Index	5.00%					
Lehman Bond	50.00%					
MSCI World	40.00%	–0.01%	2.33%	–0.14	0.52	0.67
Research Index	10.00%					
Lehman Bond	50.00%					
MSCI World	35.00%	0.12%	2.34%	–0.08	0.68	0.57
Research Index	15.00%					
Lehman Bond	50.00%					
MSCI World	30.00%	0.26%	2.38%	–0.03	0.76	0.53
Research Index	20.00%					

Note: See notes to Exhibit 5.

water transportation stocks for the period from 1985 to 1994 whether their CAPM relationship, i.e., alpha and beta, with the general U.S. stock market (S&P 500) differs between a bull market and a bear market period. Their results are partly contradictory, but do not indicate a varying relationship.

Our sample covers a bear market period in the stock market from March 2000 to March 2003 and a bull market period from April 2003 to October 2007.

Exhibit 11

Significance Test of the Diversification Properties of Investments in Shipping Stocks during the Bull Market Period from April 2003 to October 2007

Panel A: Diversification Effects of Adding the MSCI World Marine Index to a Base Portfolio with the Lehman Bond Composite Global Index (75%) and the MSCI World Index (25%)

Components	Weights	Return	Stand. Dev.	Sharpe Ratio	F-Statistic	p-Value of F
Lehman Bond MSCI World MSCI Marine	75.00% 25.00% 0.00%	0.72%	1.13%	0.38		
Lehman Bond MSCI World MSCI Marine	75.00% 20.00% 5.00%	0.79%	1.23%	0.41	0.30	0.82
Lehman Bond MSCI World MSCI Marine	75.00% 15.00% 10.00%	0.86%	1.38%	0.41	0.37	0.77
Lehman Bond MSCI World MSCI Marine	75.00% 10.00% 15.00%	0.93%	1.56%	0.41	0.30	0.83
Lehman Bond MSCI World MSCI Marine	75.00% 5.00% 20.00%	0.99%	1.78%	0.40	0.17	0.91

Panel B: Diversification Effects of Adding the Research Index to a Base Portfolio with the Lehman Bond Composite Global Index (75%) and the MSCI World Index (25%)

Components	Weights	Return	Stand. Dev.	Sharpe Ratio	F-Statistic	p-Value of F
Lehman Bond MSCI World Research Index	75.00% 25.00% 0.00%	0.72%	1.13%	0.38		
Lehman Bond MSCI World Research Index	75.00% 20.00% 5.00%	0.87%	1.26%	0.46	0.06	0.39
Lehman Bond MSCI World Research Index	75.00% 15.00% 10.00%	1.02%	1.43%	0.51	1.76	0.17
Lehman Bond MSCI World Research Index	75.00% 10.00% 15.00%	1.17%	1.62%	0.54	2.25	0.09*
Lehman Bond MSCI World Research Index	75.00% 5.00% 20.00%	1.32%	1.83%	0.56	2.57	0.06*

We conduct the tests of the main analysis again for both the bear and the bull market period. Since the results for the MSCI World Marine Index and our Research Index above exhibit some remarkable differences, we include both in the analyses. We begin with the correlation analysis (Exhibits 8 and 9).

Correlation among the three stock indexes—MSCI World Index, MSCI World Marine Index, and

EXHIBIT 11 (*Continued*)

Panel C: Diversification Effects of Adding the MSCI World Marine Index to a Base Portfolio with the Lehman Bond Composite Global Index (50%) and the MSCI World Index (50%)

Components	Weights	Return	Stand. Dev.	Sharpe Ratio	F-Statistic	p-Value of F
Lehman Bond	50.00%					
MSCI World	50.00%	1.05%	1.45%	0.52		
MSCI Marine	0.00%					
Lehman Bond	50.00%					
MSCI World	45.00%	1.12%	1.52%	0.54	0.28	0.84
MSCI Marine	5.00%					
Lehman Bond	50.00%					
MSCI World	40.00%	1.19%	1.65%	0.54	0.30	0.83
MSCI Marine	10.00%					
Lehman Bond	50.00%					
MSCI World	35.00%	1.25%	1.80%	0.53	0.16	0.93
MSCI Marine	15.00%					
Lehman Bond	50.00%					
MSCI World	30.00%	*1.32%*	*1.99%*	*0.52*	*0.07*	*0.98*
MSCI Marine	20.00%					

Panel D: Diversification Effects of Adding the Research Index to a Base Portfolio with the Lehman Bond Composite Global Index (50%) and the MSCI World Index (50%)

Components	Weights	Return	Stand. Dev.	Sharpe Ratio	F-Statistic	p-Value of F
Lehman Bond	50.00%					
MSCI World	50.00%	1.05%	1.45%	0.52		
Research Index	0.00%					
Lehman Bond	50.00%					
MSCI World	45.00%	1.20%	1.56%	0.58	0.86	0.47
Research Index	5.00%					
Lehman Bond	50.00%					
MSCI World	40.00%	1.35%	1.71%	0.62	1.47	0.23
Research Index	10.00%					
Lehman Bond	50.00%					
MSCI World	35.00%	1.49%	1.89%	0.64	1.85	0.15
Research Index	15.00%					
Lehman Bond	50.00%					
MSCI World	30.00%	1.64%	2.08%	0.65	2.06	0.12
Research Index	20.00%					

Note: Italics identify cases in which the Sharpe ratio of the base portfolio outperforms the Sharpe ratio of portfolio supplemented with shipping stocks. The formula of W has to be changed to $W = \left[\frac{\sqrt{1+s_i^2}}{\sqrt{1+s_j^2}}\right] - 1$ *Thus, the p-value refers to the null hypothesis: The Sharpe ratio of the base portfolio is significantly better than the Sharpe ratio of the enhanced portfolio. See also the notes to Exhibit 5.*

Research Index—is almost unaffected by the general stock market trend. However, correlation between the Lehman Bond Composite Global Index and all three stock indexes varies with the general stock market trend, which might exert some influence on the Sharpe ratios, to which we turn next (Exhibits 10 and 11).

For the MSCI World Marine Index, p-values are again poor, independent of the general market trend. However, it should be noted that the improvement in the Sharpe ratios is much better in the bear market. This is also true for our Research Index. But on the other hand, significance levels are markedly higher, and again very strong, in the bull market. Thus, the results for the Research Index are somewhat contradictory: The increase in diversification benefits is greater in the bear market, but the gain in diversification benefits is statistically more reliable in the bull market. The sample size for the bull market exceeds that for the bear market, which favors the detection of significant results in the bull market period. But even if we take this fact into account, the conclusion persists that the statistical basis of the diversification properties of our Research Index is much better for the bull market period. All things considered, there is some indication that the diversification properties of investments in shipping stocks might depend on the general stock market trend. According to the correlation tables above (Exhibits 8 and 9), this need not be solely caused by the shipping component. The change in the relation between bonds and stocks in general might play a role as well.

CONCLUSION

A major reason for the growing popularity of alternative asset classes is the investors' hope that alternative asset classes offer attractive returns and diversification benefits. Shipping is one of the more recent alternative asset classes. There is, in contrast to the more established alternative asset classes like real estate or hedge funds, not much research available. This article contributes to closing this gap in the literature and investigates the returns and the diversification properties of investments in shipping.

What conclusion can an investor draw from our research? Is an investment in shipping stocks recommended? During our sample period from January 1999 to December 2007, an investment in shipping stocks earned an attractive risk-return combination. From an overall perspective, we find almost no indications within our analytical framework that the addition of an investment in shipping stocks to the base portfolio worsened diversification. In most cases, increases in the Sharpe ratios were considerable, but, with some noticeable exceptions, statistically insignificant. Some details should be taken note of: First, the composition of the shipping stocks portfolio mattered prominently. The diversification benefit of the broader, equally-weighted shipping stocks portfolio of our Research Index was much more pronounced and partially even statistically significant, which is a rare event for this kind of test. Second, diversification properties were not stable through the course of time with larger diversification benefits during the bear market from March 2000 to March 2003 compared to the bull market from April 2003 to October 2007. However, the latter are statistically more reliable.

Our sample period roughly covers a full bear and bull market cycle. This allows for useful partitions into sub-periods, but our insights would be much better established if they were based on at least a second full stock market cycle. For example, an analysis of the diversification properties of shipping stocks during the subprime-downturn of the stock market, which is still in full swing at the time of writing this article, could yield useful results. Our positive overall view of the diversification properties of shipping stocks is based on a single full stock market cycle. The generalization of our results is an open question and requires further research. Moreover, an empirical comparison between investments in shipping stocks and investments in shipping exposure using instruments which are not exchange traded is recommended.

ENDNOTES

[1]The Lehman Bond indices were since acquired by Barclays Global Investors after Lehman Brothers filed for bankruptcy in September 2008.

[2]Khoo et al. [1993] put forth the information hypothesis for investments in real estate. According to this hypothesis, the returns of exchange traded investments will be highly influenced by the general stock market development and only partially reflect the situation in the real estate sector, as long as the segment of exchange traded real estate investments is rather small. With an increasing number of securities, market capitalization, trading volume, analyst coverage etc., real estate expertise in the stock market would grow and stock price quality would improve. The stock prices would then be more influenced by the situation in the real estate sector and

less by the general stock market development. Particularly before the strong IPO activity starting in 2004, the stock exchange segment of the shipping sector was rather small. Transferred to shipping, the information hypothesis states that the development of ClarkSea Index and MSCI World Marine Index could diverge because the stock exchange segment of shipping is, despite its recent growth, still quite small.

[3]An alternative procedure has been developed by Jobson & Korkie [1981]. It is not applied here, because, according to simulation results by Jobson & Korkie [1981] and Gibbons et al. [1989], the test by Gibbons et al. [1989] disposes of a greater power in case of monthly returns and small sample sizes; Hübner et al. [2004, p. 196].

[4]By abstaining from rule-based efficient portfolios, we do not have to cope with the question whether the time period used for determination of the portfolio weights should be before, or identical with, the investment period. Cheng & Liang [2000] provide evidence that this feature of the analysis could have some effect on the results. Moreover, in principle our data set would allow for the option to determine the portfolio weights in a time period preceding the investment period, though in this case a bear market period would have to be used to decide on the portfolio weights valid for a bull market period.

[5]It is tempting to consider the differences in the results for MSCI World Marine Index and ClarkSea Index in greater detail, particularly in view of the above-mentioned information hypothesis by Kho et al. [1993]. But the issue whether the incorporation of an asset, which had been quite distant from the exchange before, into the financial community affects this asset's diversification properties has to be left for future research.

REFERENCES

Akca, E.C. "Latest Major Developments in Shipping Finance." *Journal of the Black Sea/Mediterranean Environment*, 13 (2007), pp. 181–189.

Amin, G.S., and H.M. Kat. "Diversification and Yield Enhancement with Hedge Funds." *Journal of Alternative Investments*, Vol. 5, No. 3 (2002), pp. 50–58.

——. "Stocks, Bonds and Hedge Funds. Not a Free Lunch." *Journal of Portfolio Management*, Vol. 29, No. 4 (2003), pp. 113–120.

Brounen, D., and P. Eichholtz. "Property, Common Stocks, and Property Shares." *Journal of Portfolio Management*, Special Edition (2003), pp. 129–137.

Cheng, P., and Y. Liang. "Optimal Diversification: Is It Worthwhile?" *Journal of Real Estate Portfolio Management*, 6 (2000), pp. 7–16.

Christophers, H., M. Degosciu, P. Oertmann, and H. Zimmermann. "Listed Private Equity. Charakteristika einer aufstrebenden Anlageklasse." In Busack, M., ed., *Handbuch Alternative Investments*, 2, pp. 213–231. Wiesbaden: Gabler, 2006.

Clarkson Research Studies. "Sources & Methods for the Shipping Intelligence Weekly." 2005. Available at www.clarksons.net/archive/research/archive/SNM/SIWSNM.pdf, visited on April 9, 2008.

Drobetz, W., L. Tegtmeier, and M. Topalov. "Bewertung von Kommanditanteilen geschlossener Schiffsfonds mit dem Ertragswertverfahren." *Finanz Betrieb*, 10 (2008), pp. 399–411.

Eling, M. "Autocorrelation, Bias, and Fat Tails — Are Hedge Funds Really Attractive Investments?" *Derivatives Use, Trading & Regulation*, Vol. 12, No. 1 (2006), pp. 28–47.

Emery, K. "Private Equity Risk and Reward: Assessing the Stale Pricing Problem." *Journal of Private Equity*, Vol. 6, No. 2 (2003), pp. 43–50.

Ennis, R.M., and M.D. Sebastian. "Asset Allocation with Private Equity." *Journal of Private Equity*, Vol. 8, No. 3 (2005), pp. 81–87.

French, C.W. "Portfolio Selection with Hedge Funds." Working Paper, April 2005. Available at ssrn.com, id=757892, visited on April 9, 2008.

Gibbons, M.R., S.A. Ross, and J. Shanken. "A Test of the Efficiency of a Given Portfolio." *Econometrica*, 57 (1989), pp. 1121–1152.

Gong, S.X.H., M. Firth, and K. Cullinane. "Beta Estimation and Stability in the US-Listed International Transportation Industry." *Review of Pacific Basin Financial Markets and Policies*, 9 (2006), pp. 463–490.

Goulielmos, A.M. and M. Psifia. "Shipping Finance: Time to Follow a New Track?" *Maritime Policy & Management*, 33 (2006), pp. 301–320.

Grammenos, C.T., and S.N. Marcoulis. "A Cross-Section Analysis of Stock Returns: The Case of Shipping Firms." *Maritime Policy & Management*, 23 (1996), pp. 67–80.

Heidorn, T., D.G. Kaiser, and A. Muschiol. "Portfoliooptimierung mit Hedgefonds unter Berücksichtigung höherer Momente der Verteilung." *Finanz Betrieb*, 9 (2007), pp. 371–381.

Hoesli, M., and S.M. Camillo. "Securitized Real Estate and Its Link with Financial Assets and Real Estate: An International Analysis." *Journal of Real Estate Literature*, 15 (2007), pp. 59–84.

Hoesli, M., J. Lekander, and W. Witkiewicz. "Real Estate in the Institutional Portfolio: A Comparison of Suggested and Actual Weights." *Journal of Alternative Investments*, Vol. 6, No. 3 (2003), pp. 53–59.

Hübner, R., M.S. Schwaiger, and G. Winkler. "Indirekte Immobilienanlagen im Portfoliomanagement am Beispiel des deutschen Marktes." *Financial Markets and Portfolio Management*, 18 (2004), pp. 181–198.

Jobson, J.D., and B.M. Korkie. "Performance Hypothesis Testing with the Sharpe and Treynor Measures." *Journal of Finance*, 36 (1981), pp. 889–908.

Kavussanos, M.G., and S.N. Marcoulis. "Risk and Return of U.S. Water Transportation Stocks over Time and over Bull and Bear Market Conditions." *Maritime Policy & Management*, 24 (1997), pp. 145–158.

——. "Beta Comparisons across Industries—A Water Transportation Industry Perspective." *Maritime Policy & Management*, 25 (1998), pp. 145–158.

Kavussanos, M.G., A. Juell-Skielse, and M. Forrest. "International Comparison of Market Risks across Shipping-Related Industries." *Maritime Policy & Management*, 30 (2003), pp. 175–184.

Khoo, T., D. Hartzell, and M. Hoesli. "An Investigation of the Change in Real Estate Investment Trust Betas." *Journal of the American Real Estate and Urban Economics Association*, 21 (1993), pp. 107–130.

Magirou, E.F., H.N. Psaraftis, L. Babilis, and A. Denissis. "Positioning and Diversification in Shipping." Working Paper, March 1997. Available at www.aueb.gr/users/magirou/KOEREPF2.pdf, visited on April 9, 2008.

Maurer, R., and S. Sebastian. "Immobilienfonds und Immobilienaktien als finanzwirtschaftliche Substitute für Immobiliendirektanlagen." *Zeitschrift für Betriebswirtschaft*, Ergänzungsheft No. 3 (1999), pp. 169–194.

Milner, F., and E. Vos. "Private Equity: A Portfolio Approach." *Journal of Alternative Investments*, Vol. 5, No. 4 (2003), pp. 51–65.

Morawski, J., H. Rehkugler, and R. Füss. "The Nature of Listed Real Estate Companies—Property or Equity Market?" *Financial Markets and Portfolio Management*, 22 (2008), pp. 101–126.

Poddig, T., H. Dichtl, and K. Petersmeier. *Statistik, Ökonometrie, Optimierung*. Bad Soden, Germany: Uhlenbruch, 2000.

Rieck, P. "Schiffe—die Wiederentdeckung einer Asset-Klasse für institutionelle Investoren." Presentation, Marine Capital Conference, Hamburg, 6.9.2007.

Rubens, J.H., D.A. Louton, and E.J. Yobaccio. "Measuring the Significance of Diversification Gains." *Journal of Real Estate Research*, 16 (1998), pp. 73–86.

Schmidt, D.M. "Private Equity versus Stocks: Do the Alternative Asset's Risk and Return Characteristics Add Value to the Portfolio?" *Journal of Alternative Investments*, Vol. 9, No. 1 (2006), pp. 28–47.

Sharpe, W.F. "Mutual Fund Performance." *Journal of Business*, 39 (1966), pp. 119–138.

Shen, M., and A. Vogiatzis. "Portfolio Risk Management in Shipping and Optimal Asset Allocation." MSc in Maritime Economics and Logistics, October 2004. Available at www.maritimeeconomics.com/downloads/Thesis%20Meng%20S%20Vogiatiz%20A.pdf, visited on April 9, 2008.

Wahrenburg, M., D. Schmidt, and R. Reinhard. "Analyse von öffentlich gehandelten Private Equity Instrumenten aus Sicht des Asset Managements." Working Paper, May 2003. Available at www.centerofprivateequityresearch.de/publications/download_counter.php?id=4, visited on April 9, 2008.

WTO. *International Trade Statistics 2007*. 2007.

Zhu, L., J.H. Davis, F.M. Kinniry, and M.W. Wicas. "Private Equity Performance Measurement and Its Role in a Portfolio." *Journal of Wealth Management*, Vol. 7, No. 1 (2004), pp. 27–34.